January, 1995
NSRP 0439

SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

1995 Ship Production Symposium

Paper No. 3: Economics & Management of American Shipbuilding & the Potential for Commercial Competitiveness

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JAN 1995	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The National Shipbuilding Research Program, 1995 Ship Production Symposium: Paper No. 3: Economics & Management of American Shipbuilding & The Potential for Commercial Competitiveness	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Surface Warfare Center CD Code 2230 - Design Integration Tower Bldg 192 Room 128 9500 MacArthur Blvd Bethesda, MD 20817-5700**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**SAR**	**17**	

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0439

1995 SHIP PRODUCTION SYMPOSIUM

Commercial Competitiveness for Small and Large North American Shipyards

Seattle, Washington
The Westin Hotel
January 25-27,1995

Sponsored by the Ship Production Committee and Hosted by the Pacific Northwest Section of The Society of Naval Architects and Marine Engineers

601 Pavonia Avenue
Jersey City, New Jersey 07306
Phone (201) 798-4800
Fax (201) 798-4975

0439

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
601 PAVONIA AVENUE, JERSEY CITY, NJ 07306
Paper presented at the 1995 Ship Production Symposium
Westin Hotel, Seattle, Washington, January 25-27, 1995

Economics and Management of American Shipbuilding and the Potential for Commercial Competitiveness

Ernst G. Frankel (LM), Massachusetts Institute of Technology, U.S.A.

ABSTRACT

Defense conversion and commercial shipbuilding competitiveness have become major goals of the government in maintaining the U.S. shipbuilding base. The government enacted the National Shipbuilding and Shipyard Conversion Act of 1993, established a National Shipbuilding Initiative, disbursed ARPA funds for various enhancement projects, and provided support to the industry through Maritech. Yet these initiatives may not help to revive the industry and reestablish it as world class.

The reasons for the lack of competitiveness and the effects of the proposed government measures are discussed in economic terms here. The differences between U.S. and foreign shipbuilding costs are analyzed in a rational manner without subterfuge under clouds of real or imagined protection or subsidies offered. The conclusions are that U.S. government involvement in encouragement or protection has a very high price and that the U.S. shipbuilding industry may have a better chance of survival and revival with less or no government aid, protection, and involvement.

INTRODUCTION

The U.S was the world's foremost commercial shipbuilder fifty years ago and has since lost its ability to compete globally in shipbuilding. The initial decline in the post World War II period was the result of shipping overcapacity caused by left over World War II tonnage which in turn forced the shutdown of most U.S. shipbuilding capacity. The increasing inability of U.S. shipbuilders to compete and even maintain an effective commercial shipbuilding base in the U.S. was largely caused by government aids, protection, and regulation as well as the virtual monopolizing of most major U.S. shipyards by a single client, the U.S. government.

It is a basic finding of economics (Thurow, 1992) that government subsidies, aids, protection, and regulation of an industry will cause its productivity to decline. Unless an industry is forced to compete in an open marketplace without aids, market protection, and price fixing, it will not and cannot attain effective productivity and thereby a competitive position. The industry is at a stage when government demand for U.S. shipbuilding output will continue to decline and probably level off to where it requires but a small fraction of the current, already largely depleted, U.S. shipbuilding capacity.

SITUATION AUDIT

The budget request for Navy construction for FY95 is only $5.585 billion, and over the next five years, to the end of the century, Navy plans are just to build 15 DDG-51s, four LX amphibious ships, one MCM, and two TAGOS ships (Marine Log, 1994). This program will maintain a navy shipbuilding budget of barely $5.oo billion per year. On the commercial side Title XI ship mortgage loan guarantees have been increased to $1.5 billion for FY94/95 domestic shipbuilding (Marine Log, 1994). A large proportion of these funds have now been allocated but in a somewhat distorted manner with only a small percentage of these funds destined to the major U.S. yards which were to be saved from serious decline under the defense conversion policy.

Another relevant development is the proposed ten-year Maritime Security Program with a budget of $1

billion under which operators of young (less than fifteen years old) military useful ships could obtain direct annual payments of $2.5 million each for up to 32 cargo ships.

The government's shipbuilding program for conversion to competitive commercial ship construction includes ship construction loan guarantees to support sale of up to $3 billion of ships built in American shipyards, in addition to the Maritech Program which is designed to promote technology transfer, process improvements, product development, and productivity/ quality enhancement in U.S. shipyards. Maritech is supposed to also provide for improvements in shipbuilding competitiveness by encouraging industry and government partnerships as well as mutual support arrangements.

As a result of the demise of the STP (Series Transition Payment) subsidies program of the Organization of Economic Cooperation and Development (OECD) agreement this only leaves two important federal shipbuilding programs in place, the revitalized Title XI Ship Mortgage Guarantee Program and the Maritech R&D Program. The objectives of Maritech are to develop new technologies and processes for the production of commercial ships including new commercially competitive designs and marketing approaches. While these may be important and may provide U.S. shipbuilding with new products and production processes, they will not in themselves make American shipbuilding more competitive. We do not need new product and process innovation but need to learn how to better use existing process technology to build current designs of advanced ships.

The private U.S. shipbuilding industry now employs about 65,000, a number still 20% higher than the number of workers employed by all the major Japanese shipbuilding firms (shipyards building vessels of more than 10,000 DWT) which produce close to 30% of world shipbuilding output (Japan Maritime Research Institute, 1994).

THE COMMERCIAL SHIPBUILDING MARKET

World ship orders have increased since 1991 and 1992 and reached over 18 million gross tons in 1993, a volume which is expected to be exceeded in 1994 (Clarkson Research Studies, 1994). This trend will continue as a consequence of the rapidly rising increase in world ship scrapping which exceeded new orders in both 1992 and 1993, notwithstanding comparatively low scrap prices.

The decline of world newbuilding market share of Japan which dropped below 30% in the first nine months of 1993 is significant. European yards share on the other hand increased to over 20% during that period.

The tanker and bulker tonnage (dwt) delivered by the world shipbuilding industries is growing rapidly and reached 21.9 million dwt in 1994 and are expected to surpass 25.0 million dwt. These consist of

	1993	1994
Tankers	10.8 dwt	12.0 dwt
Bulkers	11.1 dwt	13.0 dwt
Total	21.9 dwt	25.0 dwt

Table I - Tanker and Bulker Construction

At the same time requirements for new tonnage has increased from a total of 485.8 million dwt in 1993 to 532.2 million dwt in 1994. This means that current shipbuilding demand is only 1/23.66 of the currently required tonnage. Similarly current supply of tonnage in 1994 was: tankers, 281.7 million dwt and bulkers, 236.5 million dwt; for a total of 528.2 million dwt, or about 7% above current (1994) required tonnage.

In other words, with an average life of tankers and bulkers now well below 20 years, particularly for very large vessels, this replacement rate is not only inadequate to maintain required fleet strength at the current average age of the fleet; but also does not satisfy the growth in demand for tonnage which is 3.0% per annum just in terms of ton-mile transport requirements. Adding the need for regulatory and technological upgrading of the fleet by substituting existing single hull with double hull tonnage, and intro-

duction of more efficient and automated vessels, adds at least another 6.6% of existing tonnage demand per year for a total newbuilding demand rate of 9.6% per year, well above the actual 4.51% rate in 1994, which was less than half the required rate of replacement (Clarkson Research studies, 1994).

Considering container ships, the situation is different. DWT on order increased from 2.5 million in 1990 and 1.9 million tons in 1991, to 2.9 million in 1992 and 4.0 million in 1993 (Clarkson Research Studies, 1994). Ships on order in 1994 are expected to reach 4.6 million dwt. This rate is equal to over 8.2% of existing fleet capacity which has an average age of less than 9.2 years (on a dwt basis) and is therefore well above replacement rate. The optimism by owners is largely. based on an expected prospects of growing trade with China, Russia, Eastern Europe, and the rest of the Pacific/Far East.

Container shipping, though currently oversupplied with an excess in slot-mile capacity of over 35%, is expected to continue to generate a growth in demand of more than 11% per year in slot miles. The prospects for world shipbuilding are therefore quite bright, notwithstanding the fact that orders in some segments of the market actually declined in 1994.

In tankers, Suez Max and handy-sized tanker orders grew substantially in 1994, while among bulkers Cape size bulker orders grew marginally. All other tanker and bulker categories actually experienced significant falls in orders in 1994.

Container ship demand similarly dropped off marginally in 1994 when compared with 1993 orders, but are still well ahead of 1992 orders.

Overall demand for new vessels has shrunk somewhat in 1994, but the value of orders has remained remarkably steady as price increases made up for volume of orders.

The brightest segment in world shipbuilding remains the special vessel category such as chemical and LNG carriers, ferries, fast special craft, cruise vessels and various types of special support vessels.

While Japan, South Korea, and China still account for about 60% of the orderbook, European yards have made a remarkable comeback and now supply nearly 20% of the world orderbook in millions of CGT. They account for over 36.9% of the world orderbook by value.

Many European and Japanese shipyards have become very productive in the last ten years and have more than doubled labor productivity during those last ten years, a trend which continues. This isolated them from the effects of the declining value of the dollar and other developments.

For example Odense now requires only 84% of the manhours of the best Japanese yards and 40% of those of a good Korean yard to build a large tanker (J. Anderson, 1993). U.S. shipyards not only have the potential of attracting foreign commercial orders with low cost Title XI financing, but have in addition the opportunity for replacing the 200-odd average tankers in the U.S. flag cabotage fleet. This alone is a market with a potential value of $10.0 billion over the next 6-8 years which is roughly the period during which most of these vessels should be replaced.

Adding to this the prospects of 1-2 cruise ships, 3-6 container ships, and an array of other vessels per year, U.S. shipbuilding could easily establish a commercial market of $3-4 billion per year, a volume which would be adequate to support U.S. commercial shipbuilding employing about 20-22,000 people. This is only about one-third of the current U.S. shipyard employment level. This business furthermore would only accrue to U.S. yards if:

1. U.S. shipbuilding productivity increased appreciably;
2. delivery times are reduced to a fraction of those currently required;
3. U.S. shipbuilding management is streamlined and the ratio of white collar to value collar workers is reduced from 1 to 3 to 1 to 7; and,
4. government gets out of regulating, subsidizing, or otherwise interfering with U.S. shipbuilding.

Total cost of cabotage is about $3.1 billion/year.

Yards must become innovative not just in product and process technology but in management and operations. The U.S. yards in general are not just obsolete in facility and process technology terms, but more importantly in terms of the way they are structured, organized, managed, marketed, and run.

The problem therefore is not just one of assuring a level playing field (often interpreted as eliminating subsidies offered to shipyards abroad) and providing government funding for product and process technology innovation, but one of restructuring the whole of the U.S. shipbuilding industry and most importantly most individual yards.

U.S. SHIPYARD LABOR PRODUCTIVITY

American shipyard workers are competent, creative, and mostly hardworking. This has been shown repeatedly from evaluations of individual shipyard worker output per unit time and in their approach to the solution of shipyard production problems. The problem is not with the workers, it is with the environment in which the worker performs. The principal factors influencing U.S. shipyard worker performance are follow.

Lack of Effective Ship Production Management

The lack of effective ship production management includes the following items: planning, supervision, inspection and physical facility/equipment provision. Management is often incompetent, inexperienced, or disorganized. As a result material and production process flows are not effectively coordinated. Tools, equipment, and material (raw material and material in process) are not delivered just in time to locations where they are required. The same applies to personnel. Inspection is often ill defined and not introduced in a continuous manner into the production or assembly flow. Similarly facilities are often not ready when and where required.

Lack of Worker and Manager Training

Training in shipbuilding as in all manufacturing must be a continuous process where workers and managers regularly undergo training. While European and Far Eastern shipyards spend 1.0-1.5% of revenues on training (an average of 8.4 and 9.2 days per year) on full-time training of everyone, U.S. shipyards spend a dismal 0.25% or one-sixth as much and most of it is expended on marketing, lobbying, and other management type training. Practically none goes for worker skill training. This has slightly improved in recent years and in response to Total Quality Management (TQM) requirements. Yet even this type of training is often wasted as many of the trainees lack basic understanding of the elements of statistics which are essential for a proper application of TQM tools and methods.

Working Conditions

Working conditions are usually poor. Not only are facilities and ships often ill maintained and dirty, but workers and supervisors often dress in indescribably filthy and inappropriate clothing. This compared to company-provided white or other color coveralls in most foreign shipyards which not only improves worker morale but also work safety and self esteem. Similarly workers will treat equipment very much like the way they are treated.

Multi-tiered Hierarchical Line Organizations

Most American shipyards are organized as multi-tiered hierarchical line organizations with as many as 18 levels between worker and yard manager. Shipyards need to have flat free form flexible organizations with some matrix characteristics which empower workers at all levels and assure proper feedback and feed forward of information. Decision functions and responsibilities must be delegated to the lowest competent level. This assures not only better and more timely decisions but also assures proper sharing and transfer of information resulting from and required for such decisions.

Casual Labor

American shipyards are among the few who still maintain a casual

labor environment where people are hired and fired all the time, instead of being allowed to move from one department or job to another to safeguard use of the workers' skill as well as his or her loyalty.

Similarly financial incentives such as profit sharing, year-end bonuses, and general recognition of contributions made by individuals should be introduced. Workers should also be given opportunities to relate to the customer, learn about the expected use of the vessel and the conditions under which the ship is expected to be used. Workers must not only feel financial satisfaction but also pride of ownership, personnel recognition, and peer acceptance.

American shipyards have lots of catching up to do in these areas. Currently U.S. shipyard labor productivity is only one-third that of Japan as noted in Table I.

	EC	Japan	U.S.
Best	26	20	60
Average	44	23	82

Table I - Shipbuilding Productivity (MH/CGT) (J. Anderson, 1993)

The most productive of EC shipyards actually achieved just under 18 MH/CGT. The average and best productivities are in Japan. At this time some of the differences in labor productivity are absorbed by the differences in shipyard labor cost (Table II).

South Korea	0.64
U.S.	1.00
Denmark	1.33
Japan	1.35
Germany	1.36

Table II - Relative Shipyard Labor Rates - in 1993 U.S. Dollar Equivalents Costs (Including Overhead and Benefits)

The continued devaluation of the U.S. dollar since December 1993 has increased the gap in relative shipyard labor costs by over 18% and therefore today Japanese and German shipyard labor costs are 52% and 54% higher than those in the U.S.

There are many reasons why U.S. yards did not achieve productivity gains, notwithstanding many years of research and development. The reasons are manyfold and include:

1. ineffective shipyard organization and management,
2. piecewise introduction of new process technology into shipyard plans and programs;
3. retention of traditional production management approaches;
4. inadequate or non-existent training of managers and workers in the use of the new technology, as well as ineffective decision making and communication;
5. lack of product design/production and process technology integration;
6. insufficient performance incentives;
7. inadequate production planning;
8. lack of enforcement of just-in-time delivery and process performance;
9. ineffective quality control and management;
10. casual labor practices and high labor turnover;
11. ineffective marketing, customer communications, long shipbuilding lead time, and consumer control over design, and certain procurements;
12. ineffective, non-responsive, hierarchical organization and management structure;
13. comparatively low level of education and training of workers, staff, and management;
14. lack of effective operational integration and intra-labor as well as labor-management communications and cooperation;
15. inadequate yardwide strategic planning of technological. change or piecewise technology introduction;
16. ineffective procurement and inventory management;
17. restrictive union practices, such as work rules, seniority systems, and opposition to technological change or changes in work procedures;
18. lack of effective design for producibility;

19. short horizon management;
20. lack of discipline, loyalty, and commitment by staff and workers;
21. ineffective incentive measures;
22. lack of organizational flexibility;
23. makeshift technology change; and,
24. no yard direction or involvement in product development.

However, much of the investment in new shipyard process technology in the U.S. was as a result not wasted. With lower labor cost, good quality labor, and currency neutrality, an effective technology base, and adequate support facilities and industries should have allowed U.S. shipbuilding productivity to close in on world class standards by now.

REASONS FOR LACK OF COMPETITIVENESS OF U.S. SHIPBUILDING

While labor productivity is an important factor of competitiveness, other factors are also important. These can be summarized as factors such as: capacity and technology of the U.S. shipbuilding industry; industry structure; government involvement; training; technology development; management organization; product development and marketing; labor/management relations; defense/industry relations; and total quality management and prescription for commercial revitalization.

U.S. shipbuilding capacity is highly imbalance in terms of commercial shipbuilding requirements. It has a large infrastructure but insufficient support technology as well as excess outfit capacity. At the same time the industry suffers under inadequate design and product development capacity, and inadequate design production integration capability. Although many of the modern manufacturing technologies were developed in the U.S., there are many examples of insufficient or improper use of advanced manufacturing methods and planning in U.S. shipyards. Similarly technology diffusion takes too long. Capacity should be rationalized and process technology be developed and introduced truly as a part of an integrated product design, producibility, production, assembly plan. In the past U.S. shipyards have often introduced new process technology because other advanced shipyards had done so and not as a result of discovery of a real need for the new process technology.

Another factor for lack of competitiveness is the structure of the U.S. shipbuilding and related support industry which is highly fragmented and often uses ineffective product strategies. It usually relies on the customer to design the product which is then constructed as a custom-built ship. Supplier-shipyard relationships are not effective with little mutual technical and marketing support. Relations with financial institutions are also either non-existing or ineffective as yards traditionally relied on the U.S. government for financing arrangements. AS a result most yards have little if any experience with creative financing, particularly if it involves international financial markets. There is little coordination of strategy among the industry and intra-industry as well as industry/government relations are more often adversarial than mutually supportive or promotional.

Past and existing government aid is fragmented and largely counter to good incentives. It has rarely helped to improve the competitiveness of the industry. Even government support of technology development is oriented mainly towards naval technology/science and largely theoretical manufacturing technology development. Government in the past did not support product development nor the development of more effective shipyard management.

It is curious to note that government frequently preferred to offer aid with strings attached instead of real incentives.

MANAGEMENT ORGANIZATION

The organization of most American shipyards did not change in many years and traditional hierarchical structures (with 9-18 levels) are still the norm. There is very little delegation of decision making to the lowest competent level nor are there serious efforts being made to level the structure to only 5-7 levels. Information systems are

still hierarchical and as a result decisions take a long time, are highly fragmented, and often inef - fective. Few yards have real time information feedback or real time information management. Data base management systems which also tie into supplier and customer information management systems.

Product development and marketing have been a low priority and few U.S. shipyards have well developed marketing organizations. Similarly, product orientation has seldom been backed up by formal market research and market development. The development of an effective market strategy would require:

1. meaningful product definition,
2. effective comparative advantage study,
3. focused product development and,
4. well structured product design and concurrent design-engineering-procurement planning and production.

It also requires product market follow-up and audit as well as product maintenance. Successful foreign shipyards as well as U.S. aircraft manufacturers, as two examples, do all of this as a matter of routine. U.S. shipyards had to be prodded by Maritech funding into product development and even then only developed a new product or ship design but performed little of the supporting activities listed above.

The industry has little experience in the establishment and nourishing of customers, and for that matter supplier, relations. It must learn to develop product-to-client "performance" requirements and build long-term relationships. Although total quality management (TQM) has been touted by the industry for some time, it is now largely introduced as a me-too perfunctory exercise and not as an essential prescription for commercial revitalization. TQM requires:

1. 'customer first" orientation;
2. streamlined organization;
3. elimination or reduction of government "aids" which are unproductive;
4. improved, integrated, and cooperative supplier relations;
5. market-oriented product development;
6. effective technology development and application;
7. management and worker training; and
8. effective relations with financial institutions and creative financing.

TQM means a move toward excellence not just in the product design and manufacture but also in:

1. management commitment;
2. customer orientation;
3. employee involvement;
4. continuous improvement;
5. enablement and empowerment of employees; and
6. definition, control and improvement of key processes.

The major reasons for failure of TQM in some U.S. shipyards has been the:

1. lack of strategic planing;
2. lack of focus on core competencies;
3. obsolete out-dated cultures; and
4. lack of results oriented management.

These are necessary to make TQM work. TQM cannot just be considered a set of basic tools and methods.

The effective implementation of TQM requires leadership, strategic intent, and boundary setting constraints. Similarly, metrics for TQM in shipbuilding must be established by the setting of effective benchmarks. These in turn must be more than simple goals - they must be achievement plans.

The labor/management relationship must be improved and changed from adversarial to cooperative relations. This will require involvement of labor in many decisions, a move toward permanent employment, and a real participatory working environment. Labor career training should not just be restricted to basic skill training but become true opportunity training. The U.S. shipbuilding industry spends less on training than any other U.S. industry and all foreign shipbuilding industries. This cannot go on if industry is to succeed.

The industry will only be able to attract young, competent workers and staff if it projects an image of professional opportunity which it does not do now.

The average age of workers in U.S. shipbuilding is well above that of any other U.S. industry including shoemaking. Similarly the percent-

age of management and senior administrative personnel in U.S. shipbuilding who have degrees in their area or discipline is lower than in any other industry. Few ever took formal courses in shipbuilding, manufacturing, engineering, or management.

COMPARATIVE PRODUCTIVITY AND COMPETITIVENESS OF U.S. SHIPBUILDING

AS noted before American shipyard workers are probably as good as any other industry's individual workers; yet U.S. shipbuilding labor productivity lags far behind that of leading shipbuilding countries. The reason for this apparent conflict is the lack of effective workplace organization and management. American shipyard workers often spend less than 40% of their work time actually performing their assigned work. The reasons include:

1. disorganized work assignment;
2. interference with other ongoing work;
3. tools and/or material required for the job not available, incomplete, or wrong;
4. insufficient information supplied for effective performance of the work;
5. wrong work assignment;
6. uncoordinated and often unnecessary inspection and tests;
7. lack of protection against weather and inappropriate work environment;
8. lack of effective work and work sequence planning;
9. ineffective or unavailable quality control requirements (these are often not measurable or interpretable);
10. inadequate supervision and management; and
11. inadequate worker skill.

The last is usually the least important in accounting for the low gross labor productivity in American shipbuilding.

As noted in Table I, U.S. labor shipbuilding productivity is only 35-50% that in good Japanese and European shipyards. Much of this difference is caused by managenent, organizational and workplace environmental deficiencies which could be overcome by a radical restructuring of the industry.

Investigating typical work environments, for example that of a structural welder, it was found that the total time the average welder actually welded was 141 minutes out of 480 minutes of a work day (E. Frankel, 1992/93). Furthermore part of the time the performance of the welder was less than optimum because of various interferences. The low percentage of actual work time was caused by lack of materials, work pieces or tools, ineffective alignment, unavailability of proper hold down clamps or other tools, and various other factors.

By comparison welders performing similar work in a Japanese shipyard achieve actual welding times of over 308 minutes in a work day (E. Frankel, 1992/93).

U.S. shipbuilding productivity also suffers under a lack of learning curve effects which benefits most foreign yards which usually have many repeat orders of identical ships offered by one or more yards.

SUPPLY CHAIN MANAGEMENT

Shipyards require effective coordination of supply to assure not only just-in-time delivery but also

1. integration of design of procured items into the vessel design;
2. coordination of systems development and integration as systems usually include supplied equipment and components from many sources;
3. integration of quality management standards and procedures of equipment and components management;
4. interface management to assure that suppliers coordinate interface requirements;
5. standardization of test and acceptance procedures; and
6. coordination of maintenance and spares requirements.

These and other supply requirements are all part of effective supply chain management which should induce yards to work with suppliers as one large procurement and manufacturing family in which each member has an equal stake in the success of the project - the delivery of the vessel.

If suppliers are simply low-cost sources of delivery of equipments or components that meet the basic specifications, without con-

tern for interface coordination and the above-mentioned requirements, then supply is not effectively managed and will cause major overruns in costs, schedules, and defaults.

Difference Between U.S. and Foreign Commercial Shipbuilding Procurement costs

The difference between American and foreign shipbuilding costs includes labor cost, material cost, equipment cost, facility use cost, and financing cost differentials. Labor cost differentials were discussed with comparative shipbuilding labor productivity. There if was found that while U.S. shipyard workers are equally proficient as an individual, their actual output is only about 40% of that of the foreign shipyard worker.

Considering that actual. burdened shipyard labor costs in the U.S. are now about 68% of those in Japan and Europe when taking the low value of the dollar into account, the comparative labor cost per unit output becomes 58.82%.

Another issue related to is higher management or overhead costs which in a typical U.S. shipyard are about 50% higher than in a comparative Japanese or European yard. This is due to both a larger percentage of administrative staff, and larger inventory and tooling costs. Both of these are the result of less effective material and work flow management. Another hidden cost to U.S. shipbuilders is associated with higher costs of government regulation and inspection.

Material and supply costs in an American yard for a typical commercial ship will usually be 15-30% higher than those of a comparable foreign yard because of

1. higher U.S. prices,
2. low volume of purchases,
3. competitive procurement which involves lengthy expensive bidding,
4. special material and component orders and requirements,
5. long delivery time,
6. financing costs of procurement,
7. test and inspection cost, and
8. administrative costs of procurement.

Not only are U.S. shipyard procurement costs higher but because yards have no long-term relationships with their suppliers, supplies are often not delivered exactly to specification, as only general and not detailed requirements can be specified.

FINANCING AND FINANCIAL COST DIFFERENCES

While most foreign shipyards have close links with financial institutions and are therefore able to assist clients with ship financing, U.s. shipyards basically rely on government construction loan and ship mortgage loan guarantees which permit reduction of certain ship financing costs. There are many creative methods of ship financing such as tax advantaged financing; purchase-sale-leaseback financing, which uses depreciation tax credits; exchange credits; and prepaid charter financing These are effectively used by foreign shipyards in assisting their clients in raising methods the required investment capital.

Although U.S. government construction and mortgage loan guarantees may reduce the cost of ship financing, they are mostly attractive to owners who cannot raise investment financing at equal or lower cost creatively in the financial markets because of their own condition.

Although government guaranteed loans usually carry interest of 1-2% less than other collateralized loans, the recent rapid increase in U.S. interest rates may make even such guaranteed loans expensive compared with loans in lower interest rate countries in Japan and Europe.

Borrowing in these countries exposes the borrower to the cost of a continuing decline of the dollar. But if the dollar does not decline further but strengthen as a result of higher U.S. interest rates, then borrowing in foreign capital markets may become a real advantage over even U.S. guaranteed loans unless the borrower is not credit worthy abroad.

Another financial cost issue is the financing of the cost of construction. The average U.S. yard requires 2-3 times as long to build a similar commercial vessel than a good Japanese, European, or Korean yard. At today's interest rates

this longer time adds 7-10% to the cost of construction because construction costs are extended by 9-18 months.

ADDED COSTS OF FACILITY USE

Longer construction time implies longer use of major facilities and equipment. If a building dock is used 12 months versus 4 months between keel laying and launch of a commercial vessel, then the cost of occupying the dock (and related equipment) for the added 8 months must be accouuted for. Furthermore the cost of the loss in opportunity of using the dock and associated equipment for other construction or repair work must be accounted for.

These costs readily add 10-18% to the cost of construction of a typical commercial ship but are often ignored in calculating the real cost of construction on the false premise that the dock has been fully depreciated. This is false financial accounting.

U.S. SHIPBUILDING COSTS

AS discussed before U.S. shipbuilding costs differ from those of foreign yards in

1. labor costs;
2. shipyard management and administrative costs;
3. supply and procurement costs, including added inventory holding costs;
4. financial costs of construction in process;
5. facility utilization costs ; and
6. cost of ship financing.

Even if the cost of ship financing, which is not under the control of the shipyard, is left out, it has been shown (E. Frankel, 1993) that U.S. shipyards suffer under severe cost disadvantages which, if all accounted for, make them non-competitive. A typical product tanker, for example, costs at least 70-110% more build in a U.S. yard than

There are some exceptions to this such as the low overhead and basic facility yards on the Gulf Coast which can build such ships at a cost which is only slightly higher than that of an average foreign yard. They achieve this by sticking to basics in terms of facilities and management and by attracting a competent, committed work force- Some are nearly greenfield yards with very low facility costs, but this is not the case with most, and particularly the larger, U.S. yards.

WORLD SHIPBUILDING PRICES AND COSTS

World shipbuilding processes generally weakened in 1993 but are becoming firmer now in 1994 (Table 111) . Profit margins in Japan and Europe for tankers and bulkers are between O% and 11%, and only a little better for container ships. The average cost of constructing a tanker was about 95% of the price. A 5% profit margin, while reasonable, does not allow for large errors.

At the same time the average secondhand price as a percentage of newbuilding prices has steadily declined from 55% in 1988-90 to 38% between 1992 and 1994, even though the average age of secondhand tonnage traded was less during the more recent period (Fearnleys, (1990-94). This implies a continued pressure on newbuilding prices.

	DWT	World Price
Tankers		
L c c	280,000	95.0
Suez Max	140,000	62.0
Aframax	95,000	44.0
Handy	40,000	32.0
Bulk Carriers		
Cape size	155,000	46.0
Panamax	70,000	28.5
Handymax	40,000	25.0
Handy	30,000	21.0
	TEUs	
Containerships		
Post-panamax	5,200	87.0
Post-panamax	4,400	78.0
Panamax	3,200	60.0
Feeder	1,200	24.0

Table III - Newbuilding Prices in Millions of Dollars (1993)

This is a difficult market in which to compete with a revitalized U.S. shipbuilding industry, whose costs will continue to be significantly higher than those of its competitors, notwithstanding the new

U.S. National Shipbuilding Initiative.

ECONOMIC EFFECT OF NATIONAL SHIPBUILDING INITIATIVE

The National Shipbuilding Initiative (Marine Log, 1994) announced with great fanfare, and embraced by the industry in general, as a savior will do little if anything for the long-term revival of American shipbuilding. It provides some basic funds for the development of shipyard products (designs) as well as for the improvement of some facilities and, most importantly, for construction and mortgage loan guarantees. While product design may, for the first time, provide yards with unique products for offer to shipping, the few products under development by individual yards are too specialized to interest a significant market. They appear to be designed more to aim at a particular, often small, customer than at a significant global market segment. In other words these product designs are not broad enough for a determined world wide marketing effort.

Similarly investment in shipyard production technology is highly fragmented to an extent where it will improve several yards marginally but no yard significantly enough to make it internationally competitive.

Finally, the $1.5 billion in loan guarantees are not going to save the industry because they provide only a marginal incentive for some U.S. and mostly foreign owners, and are quite limited in scope considering current U.S. shipbuilding costs .

The loan guarantees do not attract large customers and they are only offered briefly as their continued availability depends largely on future Congressional action.

IMPACT OF GOVERNMENT INVOLVEMENT IN U.S. SHIPBUILDING AND PROTECTION

Since 1921 (or 1936 depending on interpretation), the U.S. government has been involved in the direct support and protection of U.S. shipbuilding.

Construction Differential Subsidies. (CDS) to shipyards, a major component of the government's support system to shipyards, have been a major cause for the decline in U.S. shipbuilding competitiveness and productivity. They isolated the industry from competition and encouraged productivity decline. Together with large-scale reliance on government contracts, they also caused an inflation in shipbuilding bureaucracy and administration. It further isolated U.S. shipbuilding from the international shipbuilding market and essentially made it a ward of the state, depending mainly on Congressional budget decisions for both commercial and naval ship orders. Government dependence also affected labor-management and supplier-shipyard relationships as many conditions were written into government shipyard support and order requirements.

Thus the industry puts its faith and fortune at the mercy of government programs at a time of declining government orders and ability to economically assist the industry. True new government aid, such as loan guarantees, are now available for export orders as well, but there is a serious question if these aids will help improve shipbuilding competitiveness or simply provide some stop gap measures to limit the rate of decline of shipyard orders or employment.

While it is difficult to estimate the real cost of Maritech and loan guarantees to the nation, these costs will ultimately be on the order of $400-600 million, depending largely on changes in the rates of interest and defaults on loans.

While this may be a small sum to pay for the revival of an industry which employs 65,000 directly and about 40,000 indirectly, with revenues of nearly $10 billion, the question is if other strategies may not provide better long-term payoff in improvements in competitiveness.

The small efforts in product development and process improvement are too fragmented to really make an impact. They may assist a few yards to attract customers for a few short-run orders, but will not make U.S. yards real competitors in tanker, bulker, or container ship construction in the world market. Similarly loan guarantees will attract a few, mainly foreign orders, because they provide easy if not cheap credit, but they will do lit-

tle to improve American shipbuilding competitiveness.

It is very likely that shipyards will become dependent on these aids. whenever these aids are discontinued, which they ultimately will have to be, yards will essentially be where they were before - dependent on government aid for survival.

ALTERNATIVE APPROACHES TO U.S. SHIPBUILDING REVIVAL

American shipbuilding does not need temporary financial aid and protection, but a radical structural change. It must reinvent itself to become a mean, lean, productive, and creative ship production industry, unhampered by government rules and restrictions. It must be able to compete worldwide under terms and conditions of other global industries without restrictive requirements in procurement of supplies or sale and financing of its products. It must be able to joint venture or work with anyone worldwide.

If government wants to assist the process of revitalizing U.S. shipbuilding, it should offer real meaningful incentives for productivity improvements. These could be-:

1. income tax incentives;
2. free export or trade zone incentives (where shipyards can import supplies free of duty or restrictions for use in ships for export or even domestic clients),
3. export incentive credits (when yards obtain direct or tax incentives on export earnings) ,
4. tax incentives for money spent on training, and facility improvements, and more.

There is an array of opportunities for productivity improvement incentives. These in turn should be tied to radical reengineering of American shipyard firms. This must be done using a bottom-up approach with a view to strengthening the productive sectors and reducing the administrative sectors of the industry .

There is no reason why U.S. yards cannot build tankers and bulk carriers in 6 months and container ships in 10-12 months. It should be possible to develop a whole series of modern designs for families of the principal ship types which each interested yard can then adapt to its particular production approach using an integrated design/production approach.

It should be possible to revamp our yard/supplier relationships by bringing in foreign suppliers and developing families of suppliers and yards which agree to long-term relationships, integrated coordinated design, just-in-time planned delivery, and quality management standards. Such families would also work jointly in marketing and in developing creative approaches to construction or ship acquisition financing .

Shipyard management must be restructured by delegating decisions to the lowest competent level and reducing the levels of management to less than half the current number. In general shipyard management and administration should be reduced by 50-60% over a 3-year period. At the same time more and more shipyard workers should be made permanent employees. Training and retraining should become an integral part of work and productivity enhancing.

Total quality management shipyard procedures and standards should be developed and adopted by suppliers and yards alike, and test/acceptance procedures be standardized. In parallel all workers and supervisors should be trained-in effective TQM.

Most U.S. yards maintain old, decrepit facilities which will or should never be used again. They should abandon them and consolidate their activities in the more modern effective facilities.

During the 1985 shipbuilding recession, the Japanese shut down all obsolete yard facilities, invested only in modern facilities, and significantly improved both productivity and output capacity of the remaining yards. Comparative investment effectiveness in specific yards should be determined before improvements are made and moneys only invested where comparative productivity improvements are highest.

CONCLUSIONS

For U.S. shipbuilding to revive and become world class will require more than temporary govern-

ment initiatives such as Maritech and ship construction loan guarantees. There is a need for radical restructuring and reorganization of the industry as well as government relations with it. The industry must become truly free to perform as a global industry be provided meaningful incentives and not temporary aid. This must be done to achieve worldwide competitiveness in U.S. commercial shipbuilding and to claim its rightful place among the leading shipbuilders of the world.

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